

REMARKS

Claims 2-6 are allowed. Claims 1 and 7 were rejected as unpatentable over Marko in view of Kost. Claims 8 and 9 were objected to as depending on rejected base claim 7. Applicant requests reconsideration.

The examination has made technical errors in interpreting Kost. On page 2 of the detailed action, it is stated beginning on line 7, "However, since the claims define channelizing as the use of a plurality of A/D conversion circuits clocked by a polyphase clock generator, thus creating a plurality of digital channels, i.e., signal paths, from a complex baseband signal." The examination mistakenly states that Kost teaches channelization. Channelization involves separating a wide band signal into a plurality of frequency band signals. In claim 1 and claim 7, the limitations recite a polyphase filter bank and a transform processor, that function to separate the digital signals into respective frequency bands.

A conventional method to accomplish the channelization, termed the direct analog channelization method, is to input the composite signal of bandwidth B into a bank of M analog filters each with bandwidth B_T/M but with different center frequencies where M is the number of channels. Yet another method termed direct digital channelization method is to convert the input signal into digital form and replace each of the analog bandpass filters in the filter bank by a digital bandpass filter. Thus, the key component in terms

1 of the functionality of the channelization process is the bank of
2 filters and not the ADC as the analog implementation can work
3 without the ADC, however, the digital implementation cannot work
4 without the bank of filters. The reason to prefer digital
5 implementation compared to analog implementation is more in terms
6 of size, weight, power, and other requirements.

7
8 In the direct digital implementation, each of the digital
9 bandpass filters has to operate at a rate equal to the sampling
10 rate R_T of the input bandpass filter which by Nyquist's theorem has
11 to be at least equal to $2B_T$ and have a relatively large number of
12 coefficients N_T in its FIR implementation which is generally
13 preferred due to some important features such as guaranteed
14 stability, numerical robustness, and linear phase response compared
15 to alternative IIR filter implementation. In some real life
16 applications N_T may be equal to several thousand. The length of the
17 filter determines the size of the hardware required for
18 implementation.

19
20 Kost teaches the generation of a digital form of the complex
21 baseband signal in the form of multiple digital substreams but
22 these substreams by themselves do not correspond to the desired
23 channelized signals into frequency bands. Kost only teaches sampled
24 digital substreams are combined back to finally generate a
25 digitized version of the complex baseband IF signal which is only a
26 first step in the direct digital implementation of the channelizer.
27 The functionality of the necessary second step requires a bank of
28 digital bandpass filters or some mathematically equivalent

1 configuration, which is not taught by Kost. Thus, Kost does not
2 teach any solution whatsoever to the problem of channelization into
3 frequency bands, which is the problem solved in the present
4 invention.

5
6 Because Kost merely converts the complex baseband signal into
7 a single digital stream, after compensating for the gain and dc
8 offsets in the individual substreams. Thus, Kost only accomplishes
9 the first digitization step of the channelization process. Kost
10 never teaches polyphase channelization. In the polyphase
11 channelizer in the present invention, each of the polyphase filters
12 has only the length $L = N_T/M$ and operates at a sampling rate $R =$
13 R_T/M providing tremendous advantages when M is large as is usually
14 the case in the applications for which this invention is most
15 beneficial.

16
17 To summarize, generation of a number of digital streams from
18 an analog complex baseband or an IF signal as in Kost does not
19 comprise the polyphase channelization process whatsoever. Each of
20 the substreams, after the gain and dc offset compensation in Kost,
21 occupy the same frequency band that is not a plurality of staggered
22 frequency bands as is required for polyphase channelization. The
23 various substreams in Kost are staggered in time but not in their
24 center frequencies in the frequency domain. Only after these
25 streams are processed by a bank of polyphase filters and the FFT
26 processor as in the present invention, does one obtain the
27 channelized outputs wherein each of the individual streams at the

1 output of the FFT processor has a bandwidth of B_T/M with staggered
2 center frequencies and sampling rate reduced to R_T/M .

3
4 On page 4 of the examination, beginning on line 12, it is
5 stated that "Kost et al further teach a polyphase filter bank of
6 filters (78, 80, 82 and 84) for respectively filtering the sampled
7 I and Q quadrature baseband signals." This statement is another
8 error in interpreting Kost. Kost does not in anyway teach a
9 polyphase filter bank of filters.

10
11 Kost does not teach the use of any polyphase filtering. The
12 combination of elements 78, 80, 82 and 84 in Figure 4 of Kost does
13 not constitute any filter polyphase or otherwise. Rather, the
14 combination of elements 78, 80, 82 and 84 provides only a
15 correction to any gain and dc offset mismatch in the ADC's in the
16 bank. If for example, the ADCs in Figure 4 of Kost do not have any
17 significant mismatches as would be the case for the case of matched
18 ADCs as is often done in practice in some very important
19 applications, then the combination of elements 78, 80, 82 and 84
20 would be entirely absent in Figure 4 of Kost. Thus, Figure 4 of
21 Kost does not include the functionality of the polyphase filter in
22 it.

23
24 The concept and the functionality of the polyphase filtering
25 is completely absent in Kost. The combination of summers and
26 multipliers 78, 80, 82 and 84 in Figure 4 of Kost are only for gain
27 adjustment and dc offset adjustment. In the bank of polyphase
28 filters of the present invention, each of the polyphase filters has

1 an impulse response associated with it and has a certain
2 relationship to the impulse responses of other polyphase filters
3 such that the totality of the polyphase filters along with the FFT
4 processor behaves as mathematically equivalent to the bank of
5 digital bandpass filters used in the direct digital implementation
6 but with the tremendous advantages in terms of speed and the amount
7 of hardware required for implementation both of which are reduced
8 by factor M. Thus, for the case of $M = 256$ for example, both the
9 speed and size of the hardware required to implement the filters
10 are reduced by a factor of 256 compared to the direct digital
11 implementation. When the bandpass and the polyphase filters are
12 implemented as FIR filters as is mostly done in practice, then the
13 impulse responses of the polyphase filters are simply the staggered
14 subsequences of the impulse response sequence of the digital filter
15 with center frequency equal to 0 in the direct digital
16 implementation.

17
18 By comparison, the combination of elements 78, 80, 82, and 84
19 in Figure 4 of Kost does not have a polyphase filter or any filter
20 for that matter associated with each of the ADCs. The combination
21 of elements 78, 80, 82, 84 in Figure 4 of Kost merely provides an
22 adjustment of DC offset and a gain, which does not provide any
23 filter functionality, as the filter functionality provides a
24 frequency dependent behavior achieved by the proper impulse
25 response of the filter. Also, Kost does not have an FFT processor
26 or any equivalent as an essential component of the channelizer
27 described in the present invention. The lack of polyphase filters
28 and FFT processor or any equivalent thereof clearly shows that Kost

1 does not solve the problem of channelization which is the problem
2 solved in the present invention. Rather, Kost only solves the
3 problem of analog to digital conversion using multiple ADCs.
4

5 Marko shows a complex base band signal whereas Kost teaches a
6 real signal as the input, but neither teach polyphase
7 channelization and certainly no staggered sampling for polyphase
8 channelization. The combination of Marko and Kost does not teach or
9 suggest a bank of polyphase filters and a transform processor for
10 polyphase channelization which will be absent in an architecture
11 obtained by replacing the ADC in the Marco's receiver by the ADC
12 architecture taught by Kost as suggested by the examiner. Allowance
13 of all of the claims is requested.
14
15

16 Respectfully Submitted

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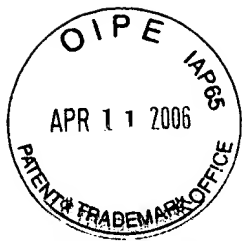
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